

MEMORANDUM

Date: April 9, 2019

BKF Job Number: 20180468-10

Deliver To: Robert Sinnott, San Rafael Fire Department

From: BKF Engineers

Subject: 350 Merrydale Road – Preliminary Fire Flow Analysis (Planning Level)

REMARKS:

Mr. Sinnott,

This analysis has been prepared to assist the fire department in assessing whether sufficient water will be available for fire protection to accommodate the proposed development. The analysis has been prepared in accordance with Appendices "B" and "C" of the 2016 California Fire Code.

Project Description and Design Criteria:

The proposed development at 350 Merrydale Road in San Rafael will consist of nine (9) new buildings providing a total of forty-five (45) residential condominium townhouse units on a ±2.3-acre lot. A new 8-inch private fire main on site will be served from the existing Marin Municipal Water District (MMWD) 6-inch public water main in Merrydale Road to accommodate an on-site private hydrant and building sprinklers for the residential buildings. Water for firefighting will also be available from a new public hydrant located along Merrydale Road.

Appendix section "B105.1" of the California Fire Code requires that the minimum fire flow and flow duration for townhouses be in accordance with Tables "B105.1(1)" and "B105.1(2)". This section of the State Fire Code also allows a 50% reduction in fire flow for these facilities if the buildings served are equipped with an approved automatic fire sprinkler system, provided that the fire flow does not drop below 1,500 gallons per minute (gpm) while maintaining 20 pounds per square inch (psi) residual pressure in the water main adjacent to the flowing hydrant.

Methods of Analysis:

For the purposes of this Memorandum, the proposed pipe network was analyzed by calculating the total anticipated head loss from the public water main in Merrydale Road to the most hydraulically distant fire hydrant located on site adjacent to Private Street 'B'. Pipes were

modeled as C-900 PVC with a Hazen-Williams coefficient of 150. System minor losses were conservatively estimated at approximately 20% of the overall pipe friction losses.

The largest proposed building on site is anticipated to have a total floor area of not more than approximately 15,000 square feet and the project architect informed BKF Engineers that the buildings would be composed of materials which conform to "Type V" construction. According to Tables "B105.1(1)" and "B105.1(2)" of the California Fire Code, the required fire flow for "Type V" buildings this size is 3,250 gpm. Since the buildings will be equipped with approved automatic sprinkler systems, the California Fire Code allows this flow to be reduced by up to 50% provided the fire flow does not drop below 1,500 gpm while maintaining 20 psi residual pressure in the water main.

Hydraulic calculations have been included herein as an Appendix.

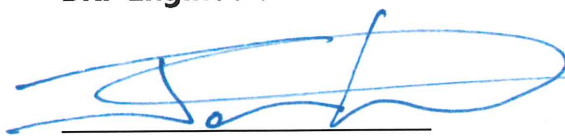
Results:

Calculations for the proposed system support the conclusion that the most hydraulically distant fire hydrant located on site will provide 1,625 gpm while maintaining residual pressures in excess of 20 psi in the private fire main. The minimum system pressure occurs at the end of the private fire main where the residual pressure drops to 59 psi while flowing the system at 1,625 gpm. Therefore, the proposed system is anticipated to substantially comply with Appendix "B" of the California Fire Code.

It should be noted that building areas, construction types, fire flow demands and other project-related parameters described in this Memorandum are anticipated values and may be subject to change with the development of Construction Documents.

Should you have any questions, or would like additional clarification on any aspect of this Memorandum, please feel free to contact us accordingly.

Sincerely,
BKF Engineers



Jason Kirchmann, PE, PLS, QSD/QSP
Vice President

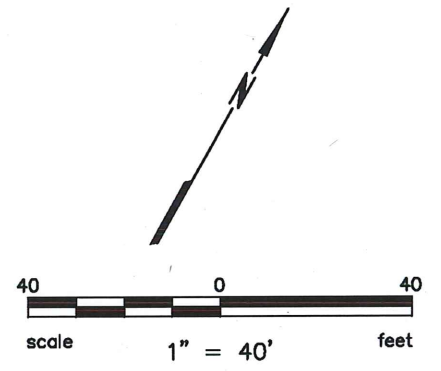
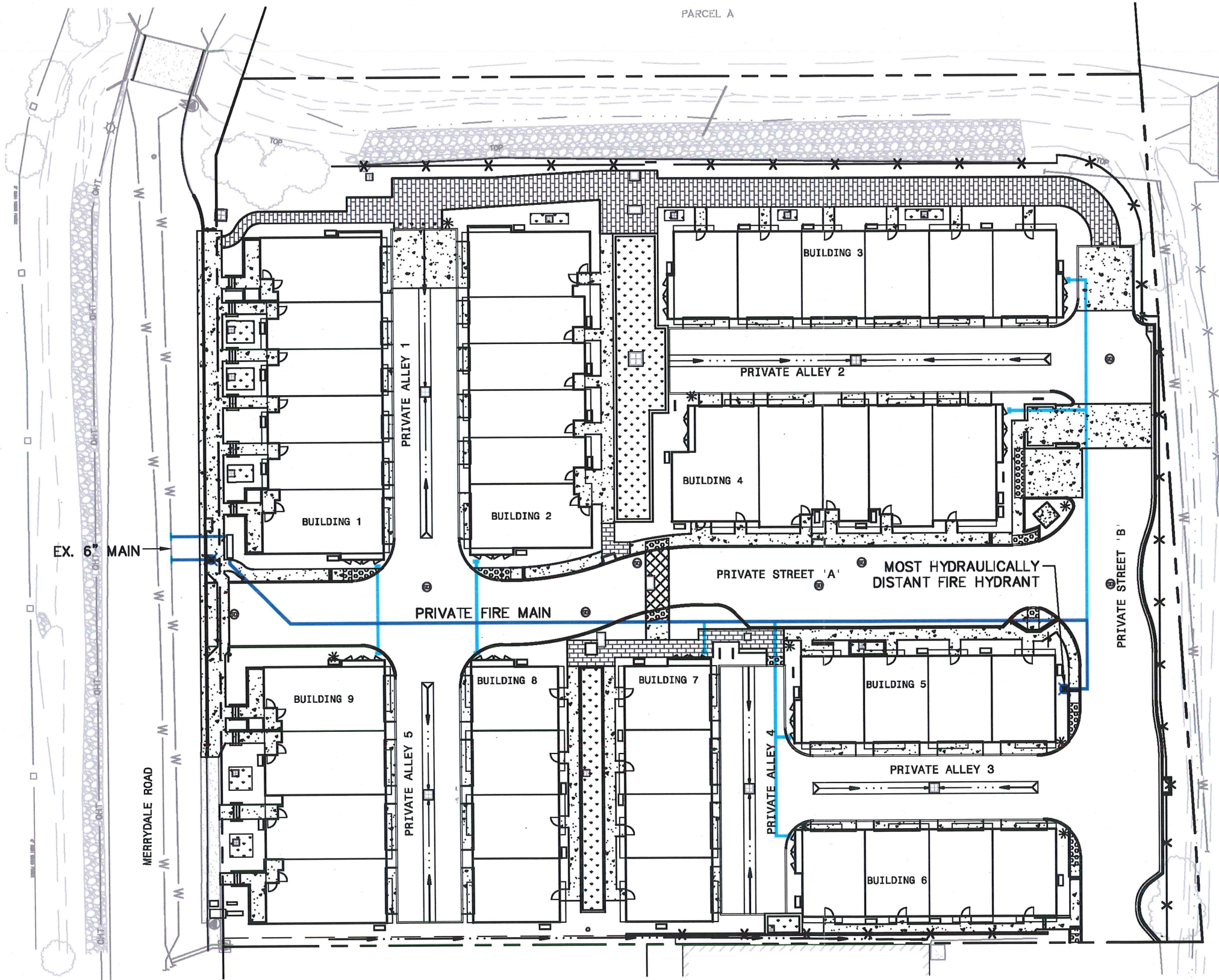


APPENDICES

Fire Flow Analysis Exhibit

Hydraulic Calculations

**2016 California Fire Code Excerpts
Tables "B105.1(1)" & "B105.1(2)"**



FIRE FLOW ANALYSIS EXHIBIT

350 MERRYDALE ROAD
 SAN RAFAEL, CALIFORNIA
 APRIL 2019

PREPARED BY



ENGINEERS / SURVEYORS / PLANNERS
 4040 CIVIC CENTER DR, STE. 530 SAN RAFAEL, CA 94903
 (415) 930-7960 FAX: (415) 930-7979

JOB NO. 20180468

SHEET 1 OF 1 SHEETS

Plot Apr 09, 2019 at 10:04am

PIONEER FIRE INC.
 1130 Industrial Ave, #5
 Petaluma, Ca 94952 (707) 762-3473
 HYDRANT WATER FLOW DATA RESULTS

HYDRANT LOCATION	HYDRANT #	Flow H		Residual H
		GPM	PSI	Static PSI
James B. Davidson Middle School 8:00 am				
280 Woodland Avenue, San Rafael	Tested 2/20/18	1		107
	Tested 2/20/18	2	803	98
	Tested 2/20/18	3	733	99
Laurel Dell Elementary & Venitia~To Be Done At Later Date				
This location not tested due to being on city property				
San Pedro Elementary School 9:00 am				
498 Point San Pedro Rd, San Rafael	Tested 2/20/18	1	782	89
	Tested 2/20/18	2	716	89
	Tested 2/20/18	3	624	89
San Rafael High School 10:00 am				
150 3rd Street, San Rafael	Tested 2/20/18	1	909	115
	Tested 2/20/18	2	890	115
Terra Linda High 11:00 am				
320 Nova Albion Way, San Rafael	Tested 2/20/18	1		108
	Tested 2/20/18	2	833	99
INSPECTIONS COMPLETED BY: RICH TOMASETTI				

HYDRANT FLOW TEST
 FROM A NEARBY SITE



Calculation of pump head parameters based on data provided by the local municipality - MMWD

Data provided by the local municipality

Static Pressure: 108 psi
 Test Flow: 833 gpm
 Residual Pressure: 99 psi
 Minimum Allowable Residual Pressure: 20 psi

Summary of pump head parameters used to model the public distribution system.

	<u>Discharge (gpm)</u>	<u>Head (ft)</u>
Shutoff:	0	249.2
Design:	833	228.5
Maximum Operating:	2,853	46.2

Sample calculation for pump head parameters used to model the public distribution system.

Shutoff Head = $108\text{psi} \times 144\text{si/sf} / 62.4\text{lb/cf} = 249.2\text{ft}$

Maximum Operating Head = $20\text{psi} \times 144\text{si/sf} / 62.4\text{lb/cf} = 46.2\text{ft}$

Maximum Operating Discharge = $833\text{gpm} \times ((108\text{psi} - 20\text{psi}) / (108\text{psi} - 99\text{psi}))^{.54} = 2853\text{gpm}$

Legend

gpm Gallons per minute
 ft Feet
 si Square Inches
 sf Square Feet
 ^ Raised to the Power

Pump Definition Detailed Report: Pump 1

Element Details		
ID	31	Notes
Label	Pump 1	

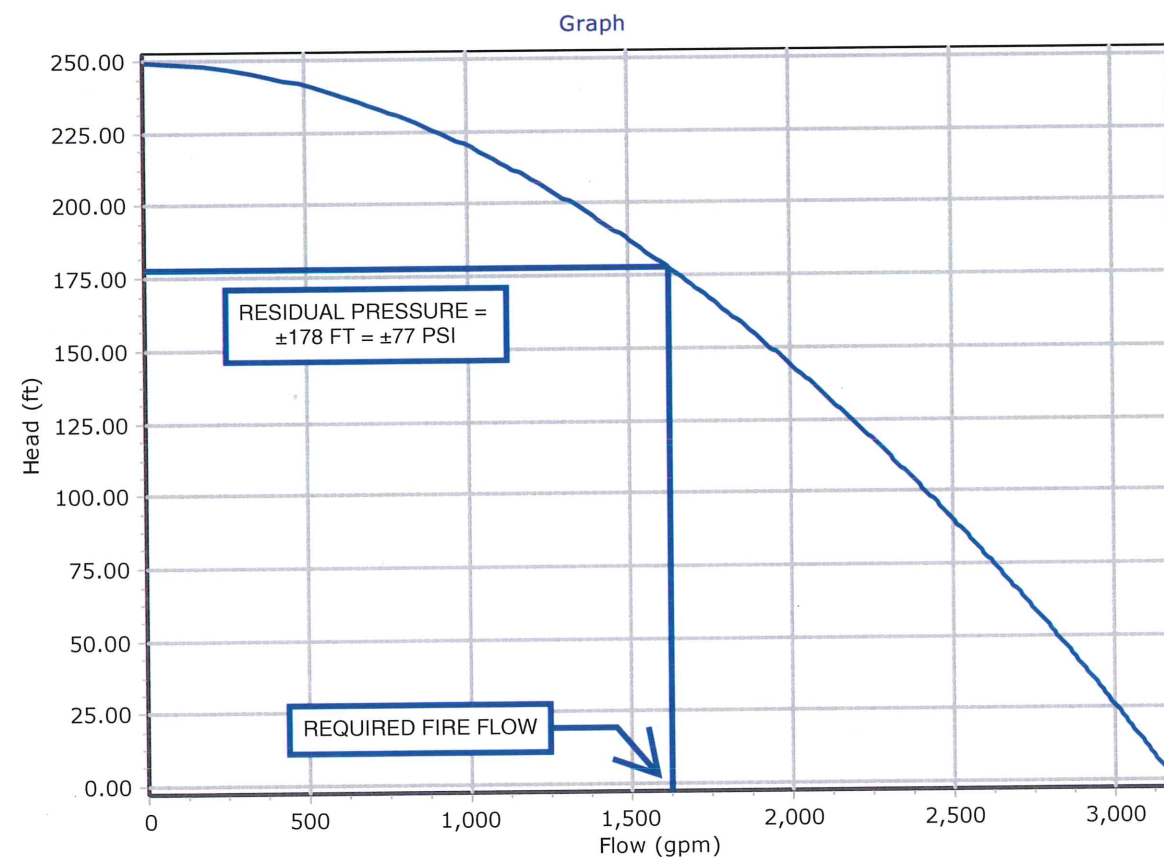
Pump Definition Type			
Pump Definition Type	Standard (3 Point)	Design Head	228.50 ft
Shutoff Flow	0 gpm	Maximum Operating Flow	2,853 gpm
Shutoff Head	249.20 ft	Maximum Operating Head	46.20 ft
Design Flow	833 gpm		

Pump Efficiency Type			
Pump Efficiency Type	Multiple Efficiency Points	Is Variable Speed Drive?	False
Motor Efficiency	100.0 %		

Flow-Efficiency Curve

Flow (gpm)	Efficiency (%)
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Transient (Physical)			
Inertia (Pump and Motor)	0.000 lb·ft ²	Specific Speed	SI=25, US=1280
Speed (Full)	0 rpm	Reverse Spin Allowed?	True



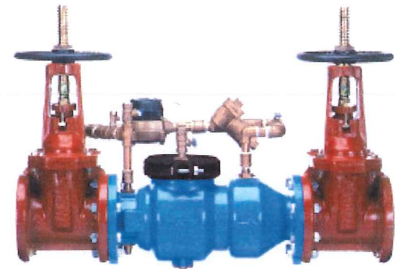


Model 350DA

Double Check Detector Assembly

Application

Designed for installation on water lines in fire protection systems to protect against both backsiphonage and backpressure of polluted water into the potable water supply. Model 350DA shall provide protection where a potential health hazard does not exist. Incorporates metered by-pass to detect leaks and unauthorized water use.



Standards Compliance

(Sizes 2 1/2" - 10" Horiz. & Vert.)

(12" Horizontal Only)

- ASSE® Listed 1048 (Sizes 2 1/2" thru 12")
- CSA® Certified B64.5 (Sizes 2 1/2" thru 8", & 12")
- AWWA Compliant C510 (Sizes 2 1/2" thru 12"), and C550
- UL® Classified (Sizes 2 1/2" thru 12")
- C-UL® Classified (Sizes 2 1/2" thru 12")
- FM® Approved (Sizes 2 1/2" thru 10")
- NYC MEA 147-99-M Vol 4 (2-1/2" - 10)
- Approved by the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California (Sizes 2 1/2" thru 12")
- Meets the requirements of NSF/ANSI 61*
*(0.25% MAX. WEIGHTED AVERAGE LEAD CONTENT)

By-Pass Backflow Assembly 3/4" Model 950XLD

Materials

Main valve body	Ductile Iron ASTM A 536
Access covers	Ductile Iron ASTM A 536
Coatings	NSF Approved fusion epoxy finish
Internals	Stainless steel, 300 Series NORYL™
Fasteners	Stainless Steel, 300 Series
Elastomers	EPDM (FDA approved) Buna Nitrile (FDA approved)
Polymers	NORYL™
Springs	Stainless Steel, 300 Series

Features

Sizes:	2 1/2", 3", 4", 6", 8", 10", 12"
Maximum working water pressure	175 PSI
Maximum working water temperature	140°F
Hydrostatic test pressure	350 PSI
End connections (Grooved for steel)	AWWA C606
(Flanged)	ANSI B16.1 Class 125

Options

(Suffixes can be combined)

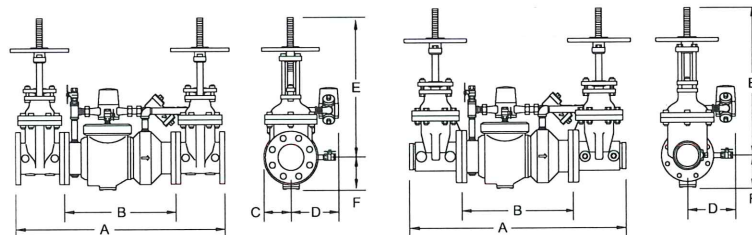
- with OS & Y gate valves (standard)
- L - less shut-off valves (flanged body connections)
- LM - less water meter
 - with remote reading meter
 - with gallon meter (standard)
- CFM - with cu ft meter
- CMM - with cu meter meter
- G - with groove end gate valves
- FG - with flanged inlet connection and grooved outlet connection
- PI - with Post Indicator Gate Valve
- GF - with flanged inlet connection and grooved outlet connection
- BG - with grooved end butterfly valves with integral monitor switches (2 1/2" - 10")
- 509 - with AWWA C509 gate valves

Accessories

- Repair kit (rubber only)
- Thermal expansion tank (Model XT)
- OS & Y Gate valve tamper switch (OSY-40)

Attention:

Model 350DA (flange body) and Model 350ADA (grooved body) have different lay lengths.



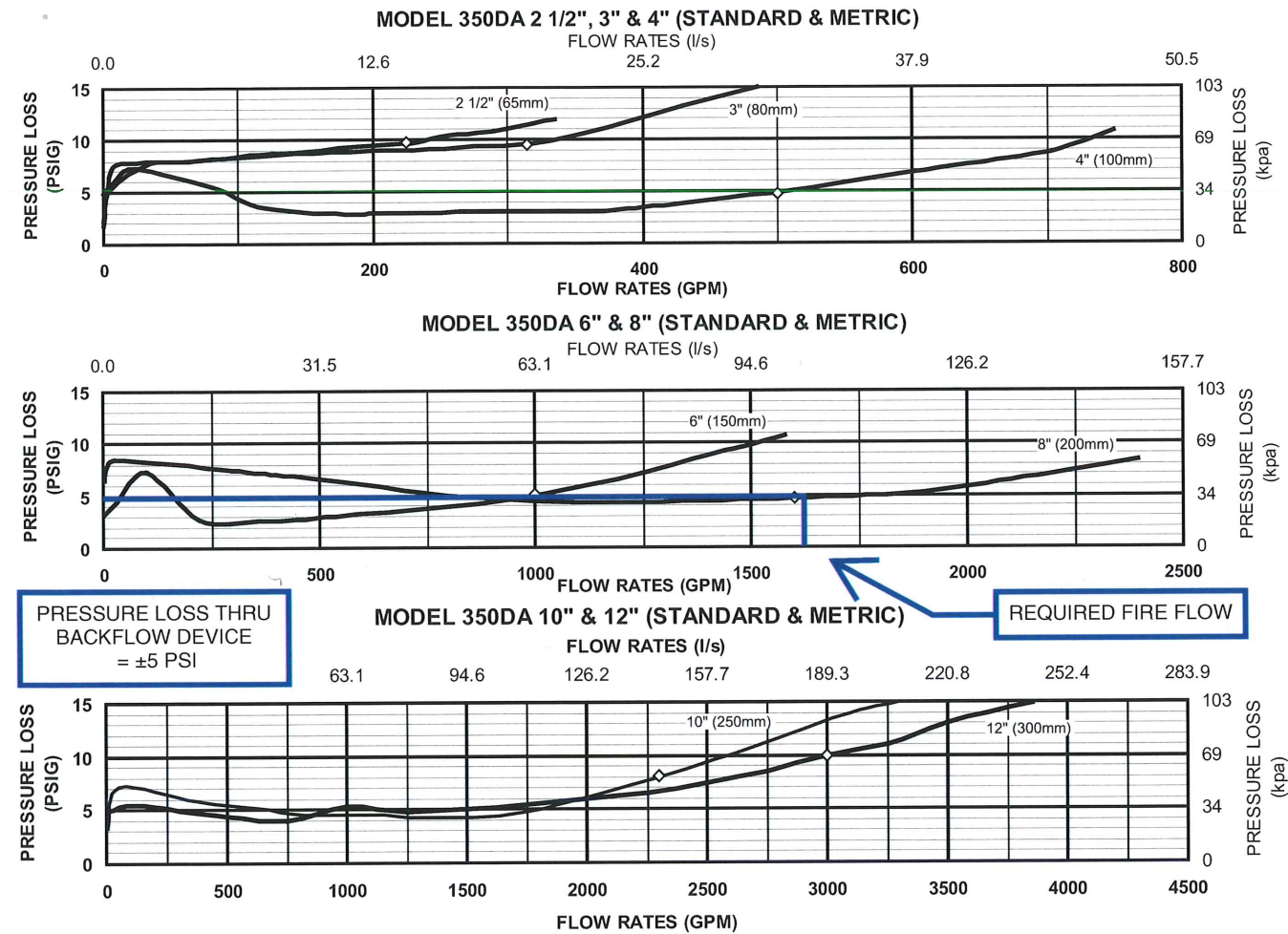
MODEL 350DAG SHOWN ABOVE

Dimensions & Weights (do not include pkg.)

MODEL 350DA SIZE	DIMENSION (approximate)														WEIGHT												
	A		A WITH BUTTERFLY VALVES		B LESS GATE VALVES		C		D		E OS&Y OPEN		E OS&Y CLOSED		E WITH BUTTERFLY VALVES		F		LESS SHUTOFF VALVES		OS&Y GATE VALVES FLANGED		OS&Y GATE VALVES GROOVED		BUTTERFLY VALVES GROOVED		
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kg	lbs.	kg	lbs.	kg	lbs.
2 1/2	65	31	787	28	711	15 7/8	403	3 3/4	95	9	229	17 3/4	451	15 3/8	391	8 1/4	210	3 1/2	89	68	31	178	81	160	73	140	64
3	80	32	813	28 1/2	724	15 7/8	403	3 3/4	95	9	229	20 1/4	514	17	432	8 1/2	216	3 1/2	89	68	31	198	90	150	68	120	54
4	100	37 5/8	956	32 8/9	835	19 1/2	495	4 1/2	114	9	229	22 1/2	572	18 1/4	464	9	229	6	152	106	48	296	134	282	128	190	86
6	150	44 3/4	1137	37 5/8	956	23 1/2	597	6	152	10 1/2	267	30 1/2	775	24 1/4	616	10 1/4	260	7	178	180	82	480	218	454	206	298	135
8	200	60 3/4	1543	53 7/8	1369	37 3/4	959	10	254	12	305	37	940	28 1/2	724	12	305	8 1/2	216	374	170	850	386	802	364	548	249
10	250	63 3/4	1619	57 7/8	1470	37 3/4	959	10	254	12	305	45 5/8	1159	34 3/4	883	13	330	8 1/2	216	404	183	1222	554	1156	524	792	359
12	300	66 1/4	1683	n/a	n/a	38	965	10	254	12	305	53	1346	40 1/2	1029	n/a	n/a	8 7/8	226	463	210	1623	736	n/a	n/a	n/a	n/a

Flow Characteristics

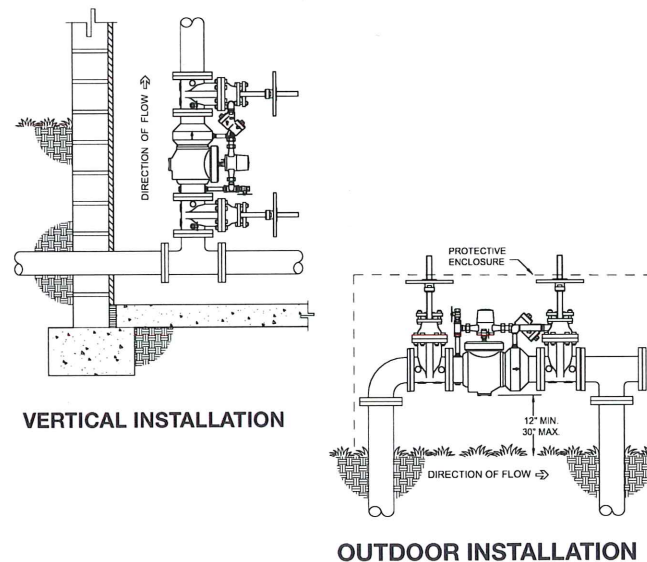
◇ Rated Flow (established by approval agencies)



Typical Installation

Local codes shall govern installation requirements. Unless otherwise specified, the assembly shall be mounted at a minimum of 12" (305mm) and a maximum of 30" (762mm) above adequate drains with sufficient side clearance for testing and maintenance. The installation shall be made so that no part of the unit can be submerged.

Capacity thru Schedule 40 Pipe (GPM)				
Pipe size	5 ft/sec	7.5 ft/sec	10 ft/sec	15 ft/sec
2 1/2"	75	112	149	224
3"	115	173	230	346
4"	198	298	397	595
6"	450	675	900	1351
8"	780	1169	1559	2339
10"	1229	1843	2458	3687
12"	1763	2644	3525	5288



Specifications

The Double Check Detector Backflow Prevention Assembly shall be certified to NSF/ANSI 61, ASSE® Listed 1048, and supplied with full port gate valves. The main body and access cover shall be epoxy coated ductile iron (ASTM A 536), the seat ring and check valve shall be Noryl™, the stem shall be stainless steel (ASTM A 276) and the seat disc elastomers shall be EPDM. The first and second check valves shall be accessible for maintenance without removing the device from the line. The Double Check Detector Backflow Prevention Assembly shall be a ZURN WILKINS Model 350DA.

Project Name:	350 Merrydale Road
Project Number:	20180468-10
Date:	3/19/2019

Initial Parameters

Static Pressure at the Main (psi)	77
Pressure Loss thru Lateral (psi)	5
Pressure Loss thru Backflow Device (psi)	5

Hazen-Williams Headloss Equation

Description	Quantity	Notes
Length of Pipe (ft)	450	
Flow Rate (gpm)	1,625	
Hazen Williams Constant (C) for Pipe	150	PVC Pipe
Pipe Diameter (in)	8	
Sub-total Anticipated System Loss (ft)	15	
Sub-total Anticipated System Loss (psi)	7	
Allowance for Minor Losses (%)	20	
Minor Losses (ft)	3	
Minor Losses (psi)	1	
Total Anticipated System Loss (ft)	19	
Total Anticipated System Loss (psi)	8	

Residual Pressure in the Main (psi)	59
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TABLE B105.1(1)

REQUIRED FIRE-FLOW FOR ONE- AND TWO-FAMILY DWELLINGS, GROUP R-3 AND R-4 BUILDINGS AND TOWNHOUSES

FIRE-FLOW CALCULATION AREA (square feet)	AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE-FLOW (gallons per minute)	FLOW DURATION (hours)
0-3,600	No automatic sprinkler system	1,000	1
3,601 and greater	No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2) at the required fire-flow rate
0-3,600	Section 903.3.1.3 of the <i>California Fire Code</i> or Section 313.3 of the <i>California Residential Code</i>	500	1/2
3,601 and greater	Section 903.3.1.3 of the <i>California Fire Code</i> or Section 313.3 of the <i>California Residential Code</i>	1/2 value in Table B105.1(2)	1

For SI: 1 square foot = 0.0929 m², 1 gallon per minute = 3.785 L/m.

TABLE B105.1(2)
REFERENCE TABLE FOR TABLES B105.1(1) AND B105.2

FIRE-FLOW CALCULATION AREA (square feet)					FIRE-FLOW (gallons per minute) ^b	FLOW DURATION (hours)
Type IA and IB ^a	Type IIA and IIIA ^a	Type IV and V-A ^a	Type IIB and IIIB ^a	Type V-B ^a		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	2
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	3
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	4
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	
—	—	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
—	—	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
—	—	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
—	—	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
—	—	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
—	—	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
—	—	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
—	—	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

For SI: 1 square foot = 0.0929 m², 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.

a. Types of construction are based on the *California Building Code*.

b. Measured at 20 psi residual pressure.